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A vesical detrusor centre in the cerebral peduncles

A VESICAL DETRUSOR CENTRE IN THE CEREBRAL PEDUNCLES.

By ISAAC OTT, M.D.,

Professor of Physiology in the Medico-Chirurgical College of Philadelphia.

THE movements of the bladder have been studied by various observers. Among the earliest was Valentin, who found that electric irritation of the cerebellum, cerebral peduncles, corpora striata, and optic thalamus always produced a contraction of the bladder, but that irritation of the cerebral hemispheres did not do so in a constant manner. Budge's experiments restricted the sphere of activity of the nerve-centres upon the bladder. Budge killed the animal, opened the abdomen, the cranium, and the spinal cord. By electric irritation he found no movements of the bladder after excitation of the cerebral hemispheres, optic thalami, corpora striata, or corpora quadrigemina; but when he irritated the cerebellum and the cerebral crura he was able to call out vesical movements. He also observed vesical action when he irritated the spinal cord, especially its anterior lower part. Volkman did not observe any movement of the bladder on irritating the central nervous system, thus throwing doubt upon the experiments of Valentin and Budge. Schiff found that irritation of the pedunculi cerebri caused movements of the bowels, stomach, and bladder. Mosso and Pellacani* believe that fibres pass from the brain through the posterior columns and posterior part of lateral columns to the motor fibres of the sphincter urethræ. They also found that extirpation of the sympathetic filaments in the dog caused no loss of either sensibility or movement in the bladder. They noted no antagonisms between the sphincter and detrusor. Sokownin found that sensory fibres which run to the bladder by way of the hypogastric nerves have their reflex centre in the hypogastric ganglion. This has been confirmed by several observers, among whom are Langley and Stevenson. Von Zeissl† found that (1) the nervus erigens is the motor nerve of the detrusor; (2) irritation of the nervus erigens opens the sphincter, and this opening ensues independent of the detrusor; (3) irritation of the hypogastric nerves causes a closure of the bladder against pressure from the urethral side; (4) in the nervus erigens there are motor fibres for the detrusor which may be likened to longitudinal fibres and inhibitory fibres for the sphincter or circular fibres, and in the hypogastric nerves there are motor fibres for the sphincter and inhibitory fibres for the detrusor. In other experiments to determine if the detrusor and sphincter acted simultaneously, he found that the sphincter opened independently, without the accessory help of the detrusor. By irritation of the cerebral ends of nerves he was able to cause opening of the sphincter or contraction of the detrusor. In simultaneous irritation of the nervus erigens and hypogastric nerves he found that the effect of the erigens, as regards the detrusor, was weakened or inhibited. As to the opening of the sphincter, this act can also be completely depressed. The inhibitory action of irritations of the hypogastric is not only exerted during the simultaneous irritation of both nerves, but it outlasts it for some time. As is well known, in the spinal cord a genito-spinal centre is located.

In some experiments published some years ago, in the Journal of Physiology, I noted that cross-section of the crura in cats was always followed by exit of urine. To make further experiments upon this subject I selected the same animals. They were bound down, etherized, carotids tied, and tracheotomy performed; then the skull was trephined and the top of the skull removed by the bone-forceps, when the brain lay like a map before me. The bladder was turned out by an abdominal section; its normal movements were noted and section of the brain commenced. After slicing away the hemispheres, removing (piece by piece) the corpora striata and optic thalami or the corpora quadrigemina, no action upon the bladder was seen. Then the tuber

* Sulle Funzione della vescica, Roma, 1882.
† Pflüger's Archiv, Bd. liii, p. 566.

cinereum was broken up; still no movement ensued. When, however, with the blunt "seeker," I cut into the crura, the bladder invariably contracted and expelled its contents. To study this movement more accurately I attached the bladder, by means of a cannula inserted through the urethra into its cavity, to a Marey polygraph. The tubing and bladder were filled by a T-shaped cannula attached to a burette filled with warm, weak, salt solution. Then, by means of a clamp near the lower opening of the burette, I was able to keep the tubing filled, notwithstanding the varying capacity of the bladder. The distension of the bladder by the salt solution was moderate.

It was found that, in this manner of preparation, the bladder at times set up a series of what I shall call "normal curves," as in Fig. 1. When the crura were punctured the curve was as in Fig. 2. The star denotes the time of injury to the crura. As is seen, it is a much more prolonged action than normally takes place. Here the mechanical irritation is the best to use, for the space is narrow and electric irritation would necessarily spread and confuse the results. This is the most anterior point in the brain that, by mechanical irritation, will produce vesical contraction. As belladonna has an excellent effect in incontinence of urine, and often paralyzes inhibition, it was given by the jugular, and then the crura were punctured. Fig. 3 shows that atropine does not prevent the action of crural puncture. One grain of atropine was given by the jugular and the crura punctured one minute after-

Fig. 1.

Fig. 2.

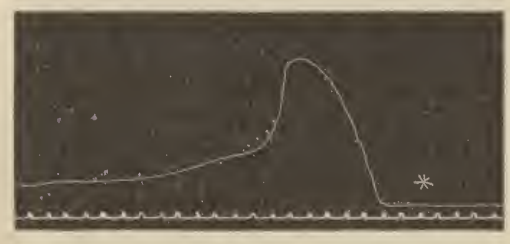

Fig. 3.

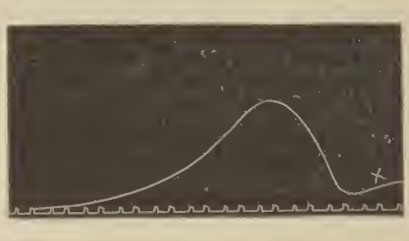

Fig. 4.

ward, which is denoted by the star. That this centre is not inhibitory is proven by the fact that when I applied the faradic current the bladder contracted, whilst if it were inhibitory it ought to have kept it quiet or relaxed it. Besides, in the puncture of the thermotaxic centres we know that the "seeker" acts there as an excitant, and not as a paralyzant. To determine the path of this irritation in the spinal cord I used the same animals. They were etherized, the cord bared at the ninth dorsal vertebra, and the dura mater divided. Then Woroschiloff's instrument was used to divide the spinal cord. After waiting a short time the animal was prepared as before and a section of the crura made. When the gray matter of the spinal cord was completely divided, puncture of the crura still produced vesical contractions, as in Fig. 4. The star denotes the period of puncture. When the posterior columns were alone divided, crural irritation still caused a contraction of the bladder; when the anterior columns of the spinal cord were only divided, a contraction ensued upon injury to the crura; but when both lateral columns were divided, no result ensued from puncture of the crura.

These experiments conclusively showed that the influence transmitted from the gray matter in the cerebral peduncles to the vesical detrusor went through the lateral columns of the spinal cord.

The theory of the action of the bladder is assumed to be as follows: An automatic centre in the spinal cord which keeps up the tonic action of the sphincter, and a reflex detrusor centre seated higher in the spinal cord. Both these centres are under the domination of a cerebral centre. According to Landois the inhibitory fibres concerned in the reflex inhibition of the sphincter urethræ probably arise from the optic thalamus. The experiments of Zeissl show that both the detrusor and the sphincter can act independently of each other; but the centre, I have discovered, is not an inhibitory centre, but an excitor of the detrusor. To decide through what nerves this centre acts, whether through the nervus erigens or the hypogastric nerves, will require further experimental work.

When the act of micturition takes place the spinal detrusor centre is excited into activity by the pressure of the urine; the sphincter automatic centre is independently excited by the pressure of the urine and opens to expel the secretion. The spinal detrusor and the spinal sphincter are under the control of the detrusor of the cerebral crura, which is set in activity by the cerebral hemispheres in voluntary micturition. That an act of inhibition comes into play is true, but its central connection is still to be explained.

The number of experiments performed was thirty-six.

Physiological Laboratory.